The Bridport Calcilutite

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Abstract

The term Bridport Calcilutite is proposed for the sequence of Holocene sediments consisting predominantly of homogeneous to bioturbated carbonate mud and shelly carbonate mud. These sediments occur in the contemporary marine environment and in the subsurface of the coastal zone of the Swan Coastal Plain. The sediments have formed as submarine basin deposits in deep water quiescent environments in proximity to seagrass banks.

Introduction

The Holocene coastal zone of the Perth Basin presents a variable suite of facies and sedimentary deposition systems that include aeolian sands, beach deposits, seagrass bank accumulations, deltas, estuarine accumulations and sediments of the nearshore shelf and coastal rocky reefs. Generally each of these depositional systems are distinct in their mode of sedimentation, and they generate sediment accumulations which are of sufficient size and extent to be recognised as formations. Indeed, the various major types of Holocene coastal sediment accumulations already have been formally recognised as formations: e.g. the Safety Bay Sand, the Becher Sand, the Lesehenault Formation (Passmore 1970; Playford *et al.* 1976; Semeniuk 1983; Semeniuk and Searle 1985).

Additional stratigraphic studies along the coastal and marine environments of southwestern Australia have further delineated a suite of coastal sediments, that have distinct lithologic characteristics, which should be formally assigned formation status. It is the purpose of this paper therefore to establish a new formation, the Bridport Calcilutite, for a sequence of Holocene deep water marine carbonate muds and shelly muds in the coastal region of southwestern Australia.

Data for this paper were obtained from coastal plain and submarine environments by reverse air core drilling, air-lift drilling and intact cores. Locations of drill sites that intersected the Bridport Calcilutite are shown in Fig. 1.

Regional Setting

The study area is set along the coastal zone and nearshore marine environment of the Rottnest Shelf of southwestern Australia (Carrigy and Fairbridge 1954). This coastal system is comprised of Holocene sediments as well as erosional surfaces cut into Pleistocene materials, and encompasses the seaward extremity of the Swan Coastal Plain, a Quaternary sedimentary system of the Phanerozoic Perth Basin (Playford *et al.* 1976).

The most important sites of sediment accumulation along the southwestern coast occur in the Cape Bouvard-Trigg Island sector of Searle and Semeniuk (1985). This sector is characterised by shore-parallel limestone ridges, in various stages of erosional degradation, with intervening deeper water marine depressions (Searle 1984). Holocene sedimentation, mainly restricted to loci termed accretionary cells (Searle 1984), has formed platforms, east-west oriented banks and subaerial promontories that span and segment the most eastern marine depression (the Cockburn-Warnbro Depression) to form a series of basins (Searle and Semeniuk 1985).

The shallow water submarine banks and platforms are seagrass-covered and are sites where seagrass-derived sediments (bioburbated to shelly quartzo-skeletal sand and muddy sand) accumulate to form deposits referred to as Becher Sand (Semeniuk and Searle 1985). In the deeper water marine basins, where depths are >18 m and sediment floors are extensive, flat and featureless, there is accumulation of carbonate mud and shelly mud. These carbonate mud deposits have been described sedimentologically by Carrigy (1956) and Searle (1984), and are the lithotope of the Bridport Calcilutite, the subject matter of this paper.

Definition of the Bridport Calcilutite

The Bridport Calcilutite is the formation name proposed for the sequence of grey, structureless to bioturbated, calcareous (carbonate) mud with lesser shelly carbonate mud. The formation forms the floors and underlies modern (contemporary) deep water marine basins, and also occurs in the subsurface, typically underlying the Becher Sand. The formation name is derived from Bridport Point, in the southern part of Warnbro

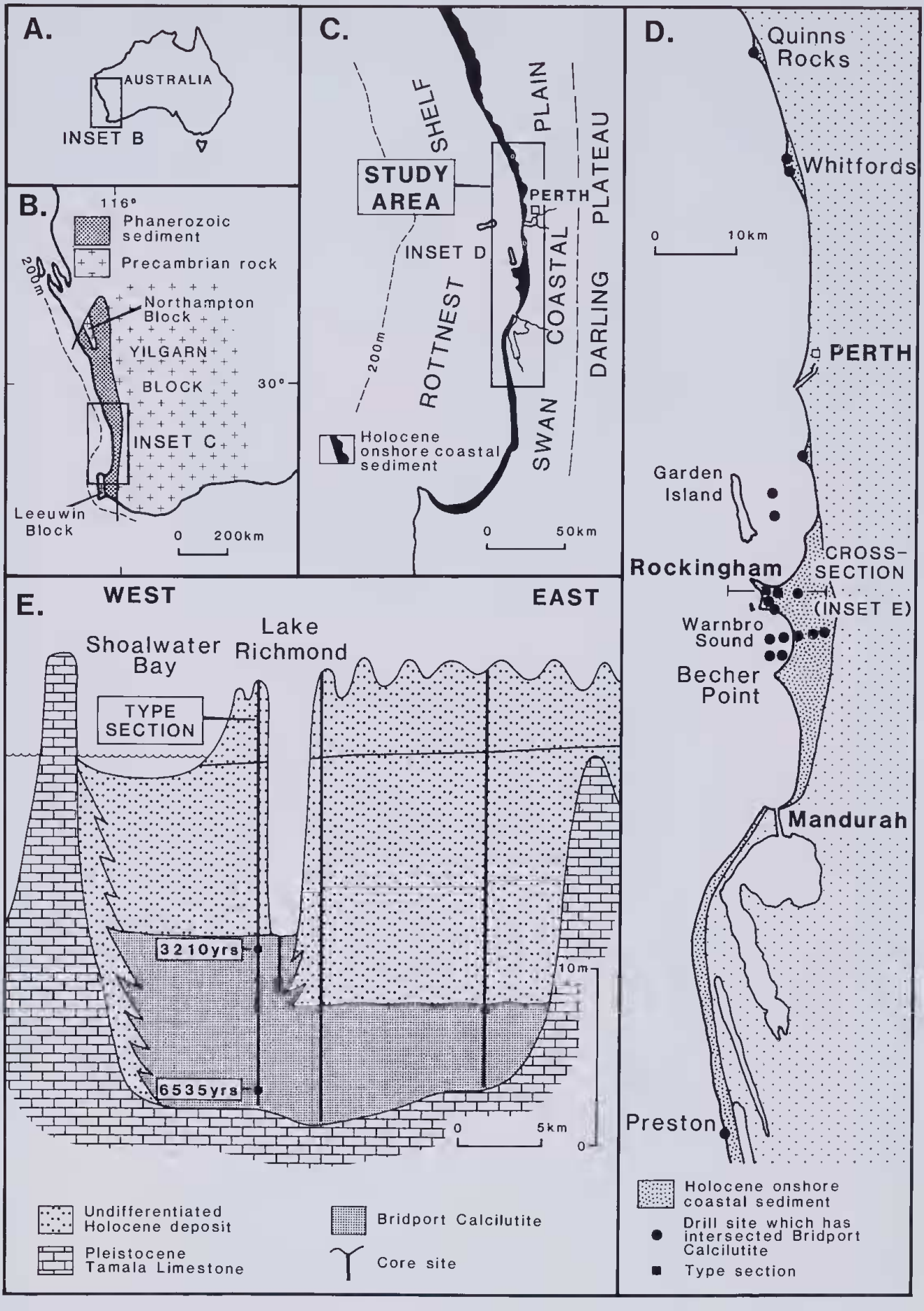

Figure 1.—A and B. Locality diagram and setting within the Perth Basin.
C. Location of study area.
D. Location of drill sites where Bridport Calcilutite has been intersected.
E. Stratigraphic cross-section showing extent, thickness and east-west geometry of the Bridport Calcilutite along a transect situated near Rockingham. Radiocarbon ages within the Bridport Calcilutite at the type section are samples GX12904 and GX12903; both have been corrected for C13.

Sound, which is a basin where the Bridport Calcilutite is accumulating. The lithologic term calcilutite is aptly applied in that the proposed formation consists of calcareous lutaceous sediment (Bates and Jackson 1980).

Type Section: The eore site on the west shore of Lake Richmond, in the Rockingham area, is designated as the type section (Fig. 1). Material from the eore has been lodged with the Geological Survey of Western Australia. The sequence within the type seetion is described as follows:

Top (Becher Sand): fine to very coarse grey carbonate/quartz sand, locally shelly ..... 10.5 m

Bridport Calcilutite: homogeneous, grey/fawn, carbonate mud with seagrass fibre ..... 6.0 m

homogeneous, grey, carbonate mud with shell ..... 0.5 m

homogeneous, light grey, carbonate mud ... 3.0 m

Base (Tamala Limestone): calcreted aeolianite limestone ..... 2.0 m

Distribution: The Bridport Calcilutite has been intersected in numerous eores and its distribution, both eontemporary and subsurface, is widespread (Fig. 1).

Geometry and Thickness: The formation is up to 10 m thick under the eoastal plain in the Rockingham area. Elsewhere the formation is generally 2-6 m thick. In localities where it is eontemporary, the unit forms a sheetlike to lens-like body on basin floors. In the subsurface where it has been buried by the Becher Sand, as in the Becher Point-Rockingham Plain area, it forms a seaward thickening wedge body, or a thiek prism.

Lithology: The dominant sediment in the formation is grey, structureless to bioturbated, calcium carbonate mud composed of clay-sized and silt-sized carbonate material. Locally there are layers with marine shells, layers of laminated calcareous mud, and horizons of seagrass fibre and seagrass peat.

Stratigraphic relationships: The formation overlies the following units:

1. Tamala Limestone (sharp unconformable contact).
2. Cooloongup Sand (bioturbated to gradational unconformable contact),
3. Mud of the Lesehenault Formation (bioturbated, gradational, conformable contact).

The formation may be overlain by the bioturbated, grey sediments of the Becher Sand, and the contact is conformable and mostly sharp.

Age and fossils: The Bridport Calcilutite is wholly Holocene. Radiocarbon ages from shells in the unit are less than 7 000 C14 yrs BP (Fig. 1). The Bridport Calcilutite is locally shelly and mollusc shells predominate. Molluscs include *Bittium granarium* and *Chlamys* sp. with less common *Clanculus ?plebejus, Cantharidus lepidus, Cantharidus irisodontes, Ethminolia ?vitiliginea, Diala* sp, *Nassarius pauperatus,* and *Brachidontes ustulatus.*

Discussion

The sediments referred here to the Bridport Calcilutite originally were considered part of the basal portion of the Becher Sand (see "unit of fawn coloured mud with seagrass fibre", Table 2 of Semeniuk and Searle 1985; "marine mud unit" in figure 2 of Semeniuk and Searle 1985; and "mud" in Figure 3 of Semeniuk and Searle 1986). However, the extensive drilling in the Rockingham-Becher Plain area has shown that the distinctive carbonate mud unit underlying the Becher Sand is up to 6 m thick, and that it is substantial enough in thickness and extent to be recognised as a separate formation. Drilling elsewhere, such as at Preston and Whitfords-Quinns Rock area, also has shown that the formation is not restricted just to the Cape Bouvard-Trigg l. coastal sector.

The occurrence of the unit has palaeo-enviromental implications. In the modern environment the formation is accumulating in quiescient, protected, deep water marine basins sueh as Warnbro Sound and Cockburn Sound. The mud is derived from adjoining seagrass bank environments where wave agitation and reworking entrains fine carbonate sediment into the water column. The suspended mud finds its way into the basins and settles out as a suspension deposit. Periodically, the substrates of the basin are inhabited by a mollusc fauna which contribute their remains to the sediment to form shell layers. The Bridport Calcilutite thus represents deposits of quiescent deep water marine basins that adjoin, or are protected by, seagrass bank environments.

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